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[West Vancouver, BC]

1987 ANNUAL REPORT

LEADED AND LEAD-FREE GASOLINE REGULATIONS MONITORING PROGRAM

Regional Program Report 87-24

By

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ABSTRACT

This report describes the gasoline monitoring programs conducted in British Columbia during 1987. Samples of leaded and lead-free gasoline were collected and analyzed to check the lead content and verify compliance with the Leaded and Lead-Free Gasoline Regulations published pursuant to the Clean Air Act.

Surveys were also conducted to investigate the practice of nozzle switching on leaded gasoline dispensing pumps at retail outlets and the practice of motorists misfueling vehicles that are designed to use lead-free gasoline.

RÉSUMÉ

Ce rapport décrit les programmes de surveillance de l'essence menés en Colombie Britannique en 1987. Les échantillons d'essence avec etsans plomb ont été recueillis et analysés pour vérifierr le contenu en plomb et en vérifier la conformité avec les règlements sur l'essence sans plomb publiés selon la loi sur la qualité de l'air.

Autres études furent aussi conduites. L'une visait à déterminer l'ampleur des pratiques de changement du bec verseur de pompes distribuant de l'essence sans plomb tandis que l'autre examinait les pratiques des automobilistes remplissant leurs véhicules conçus pour de l'essence sans plomb avec une essence non designée.

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SUMMARY

The Pacific and Yukon Regional office of Environmental Protection, Environment Canada monitors the lead levels in leaded and lead-free gasoline sold in British Columbia to ensure compliance with the federal Leaded Gasoline and Lead-Free Gasoline Regulations under the Clean Air Act. The monitoring results indicate a continuing trend towards improved compliance with respect to the rates of lead-free gasoline contamination, nozzle switching on dispensing pumps and vehicle misfueling. While the leaded gasoline sampled from the production plants complied with the new standard of 0.29 grams of lead per litre, which became effective January 1, 1987, the samples collected from retail outlets were not in compliance one hundred percent. Seventeen (17) out of fifty eight (58) or 29% of these samples contained lead in excess of 0.29 g/L, with one sample containing more than 0.44 g/L. These results indicate that earlier production gasoline with higher lead content remained in the marketing system at the time of sampling.

Nozzles of leaded gasoline pumps were also checked, and 20 out of 620 nozzles were undersized. The nozzle switching rate was therefore 3.2%.

In a survey of misfueling practices at 7 Vancouver area retail outlets, a total of 498 vehicle refuelings were observed. Eight (8) motorists refueled with leaded gasoline to their cars that were designed for lead-free gasoline. Consequently 3-4% of the lead-free burning cars were misfueled. This rate indicates a reduction from 13% in 1985 and 5-7% in 1986.

A summary of the survey results is presented in Table 1.

SUMMARY
(continued)

TABLE 1 SURVEY RESULTS OF LEAD-FREE GASOLINE MONITORING AND NOZZLE SWITCHING

YEAR	TOTAL GASOLINE SAMPLES	CONTAMINATIONS	RATE OF CONTAMINATIONS	TOTAL NOZZLES SURVEYED	UNDER-SIZED NOZZLES	NOZZLE SWITCH RATE
1974	317	7	2.2 %			
1975	207	3	1.5 %			
1976	284	12	4.2 %			
1977	637	11	1.7 %			
1978	93	6	6.5 %			
1979	155	15	9.7 %			
1980	251	5	2.0 %	522	0	0 %
1981	311	9	3.0 %	434	43	10 %
1982	-	-	-	-	-	-
1983	331	6	1.8 %	626	457	73 %
1984	398	10	2.5 %	887	123	14 %
1985	567	15	2.6 %	1215	114	9 %
1986	358	5	1.4 %	781	49	6 %
1987	268	2	0.8 %	620	20	3.2 %

SURVEY RESULTS OF LEADED GASOLINE MONITORING

YEAR	TOTAL GASOLINE SAMPLES	NON-COMPLIANCE	RATE OF NON-COMPLIANCE
1987	58	17	29%

1 INTRODUCTION

Lead is a toxic element to human health. Fortunately, advances in industrial hygiene have virtually eliminated acute lead poisoning. But chronic exposure to low levels of lead are known to interfere with haemoglobin synthesis and are suspected of causing neurophysiological and behaviorial effects, teratogenic effects, growth inhibition and hypertension. Children are thought to be particularly susceptible to the adverse effect of lead.

In 1973, Canadian emissions of lead from gasoline peaked at 14,360 tonnes accounting for approximately 70 per cent of total Canadian lead emissions to the atmosphere. In 1985, the total lead emissions was reduced to 6000 tonnes, but still account for 61 per cent of total lead emissions in Canada. Effective January 1, 1987, the maximum allowable lead content was reduced from 0.77 grams per litre to 0.29 grams per litre. The Minister of Environment has announced the goal to effectively phase out lead in gasoline by 1993.

In order to reduce exhaust emissions, car manufacturers have used a device called a "catalytic converter" in many post 1975 automobiles. This device cleans the exhaust gas before emitting it to the atmosphere and is capable of reducing carbon monoxide and hydrocarbon emissions by 80% to 90%. The cleaning action of the catalytic converter is achieved by the action of special metal catalysts. The catalyst converts the harmful carbon monoxide and hydrocarbons into relatively harmless water vapour and carbon dioxide gas. Recently, a new 3-way catalyst can, at the same time, reduce the emissions of carbon monoxide and hydrocarbons as well as oxides of nitrogen. The 3-way catalyst is required to meet the new or more stringent car exhaust emission standards that became effective in September, 1987 for 1988 model year production vehicles.

Catalytic converters cannot tolerate contaminants such as lead in gasoline. [4]When burned in the combustion chamber of an engine, the lead in gasoline becomes fine particles of metallic lead. These fine lead particles

form a coating over the catalyst and reduces its cleaning action by "poisoning" the catalyst. Several tank refills with leaded gasoline can poison the catalyst extensively and render the converter useless.

Federal Regulations were promulgated in 1974 to limit the maximum lead concentration to 0.013 grams per litre in lead-free gasoline to ensure that the platinum catalyst is protected from damage. Some provincial governments including Ontario, Nova Scotia and Quebec have passed regulations to prohibit nozzle switching at gasoline retail outlets. In April 1987, British Columbia added a 2¢ per litre sales tax to leaded gasoline, which resulted with price equalization for leaded and lead-free gasoline and has removed what appears to have been a major incentive of some motorists to misfuel their cars. At the same time, the petroleum refining industry designed and implemented strict procedures for gasoline handling to ensure that the lead-free gasoline products are not contaminated by lead.

The car manufacturing industry together with the petroleum industry sought to avoid misfueling of cars by introducing a special fuel inlet restrictor inside the fuel filling pipe on cars that are only compatible with a small diameter nozzle on lead-free gas dispensing pumps. A car requiring lead-free gasoline has an inlet restrictor that can only receive gasoline from a nozzle size of 20.6 mm (13/16 inch) outside diameter. All pump nozzles for dispensing leaded gasoline are larger and have an outside diameter of 23.8 mm (15/16inch) which prevents its use in any lead-free gas tank receptor.

If a small size nozzle (13/16" O.D.) is installed on a leaded gasoline pump, the retailer is providing an opportunity for dispensing leaded gasoline to a lead-free burning car, either intentionally or unintentionally. Some vehicle owners remove the inlet restrictor so that the vehicle can be deliberately misfueled. Both of these practices circumvent the intent of the emission control technology on cars and should be discouraged or prohibited.

The Pacific and Yukon Regional office of Environment Canada has been conducting surveys on the lead content in gasoline and nozzle switching practices for a number of years. In each of the past two years, an additional survey was conducted to investigate the misfueling practices by motorists. This report presents the 1987 results from all these surveys.

2 LEADED GASOLINE MONITORING

The leaded gasoline survey includes the sampling of gasoline production plants and retail outlets in B.C., typically the Vancouver area and the Okanagan area. Gasoline retail outlets in urban centres were visited without predetermination of time, location or brand. The petroleum refineries were sampled approximately once per quarter of a year.

Samples of leaded gasoline were analyzed using the atomic absorption method.

3 LEAD-FREE GASOLINE MONITORING

The lead-free gasoline survey is based on a spot check of retail outlets in several geographical areas in B.C., typically the Vancouver area and the Okanagan area. Gasoline retail outlets in urban centres were visited without predetermination of time, location or brand. A surveyed area would not be revisited in the same year unless a serious contamination problem had been identified.

Samples of lead-free gasoline were collected at retail outlets and were analyzed the following day using a quick test colorimetric analyzer. When a high lead concentration was detected by the quick test, the sample was then analyzed again using the atomic absorption method to confirm the quick test result.

4 NOZZLE SWITCHING SURVEY

The nozzle switching survey was conducted in conjunction with the gasoline sampling program. The size of nozzles on leaded gasoline pumps was checked with a plastic template (Figure 1).

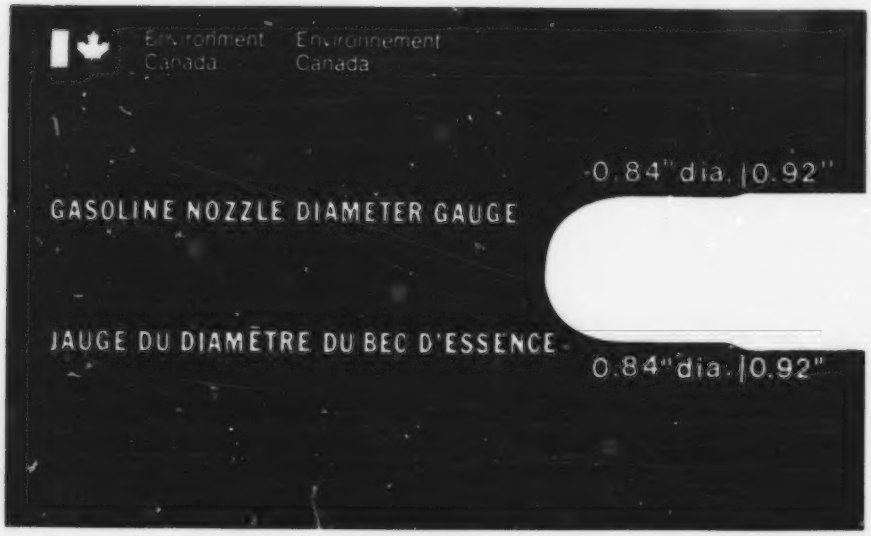

FIGURE 1

PLASTIC TEMPLATE FOR NOZZLE SIZE MEASUREMENT

The template can be used to quickly check nozzle size and identify undersized nozzles. Table 2 shows nozzle sizes that have been encountered.

TABLE 2 NOZZLE SIZE OF GASOLINE DISPENSING PUMPS

NOZZLE SIZE	OUTSIDE DIAMETER		INDICATION ON TEMPLATE	IMPLICATION
	mm	Inch		
Large	23.8	15/16	Does not fit into opening	Correct size to dispense leaded gasoline.
Small	20.6	13/16	Fits into inner opening	One can dispense leaded gasoline easily to cars requiring unleaded gasoline.
Medium	22.2	14/16	Fits into outer opening	One can dispense leaded gas to cars requiring lead-free gas by forcing the nozzle into the receptor neck.

5 MISFUELING SURVEY

A separate survey was conducted in Vancouver to assess the practice of misfueling cars. In this survey, a technician observed vehicle refueling and interviewed motorists at 7 retail outlets, spending one day at each outlet. Information was recorded on the total number of vehicles refueled, type of fuel required for each vehicle, the presence or absence of the fuel inlet restrictor in the fill pipe, and the reason for using leaded gas. A copy of the survey data sheet is included in Appendix I.

6 RESULTS

6.1 Leaded Gasoline Monitoring

Leaded gasoline production plants in B.C. were sampled prior to 1987 and in each quarter of this year. All samples were in compliance with the Regulations.

TABLE 3 LEAD CONCENTRATIONS IN LEADED GASOLINE SAMPLES FROM B.C. PRODUCTION PLANTS

	Lead Concentrations in gm/litre (Production Plant)		
4th Quarter 86	0.59(ESSO)	0.37(SHELL)	0.49 (PORT MOODY)
1st Quarter 87	0.27(ESSO)	0.21(SHELL)	0.19 (HUSKY)
2nd Quarter 87	0.28(TAYLOR)	0.28(KAMLOOPS)	0.21 (CHEVRON)
3rd Quarter 87	0.23(ESSO)	0.20(SHELL)	0.16 (CHEVRON)
	0.20(PORT MOODY)		

A total of 58 samples were collected from retail outlets. One sample (2%) contained in excess of 0.44 g/L and 17 samples (29%) contained 0.29-0.44 g/L of lead. Forty samples (69%) contained less than 0.29 g/L of lead. The results are summarized in Table 4.

The average lead concentration from various brands are as follows:

Chevron:	12 samples	Average	0.286 g/L
Shell:	4 samples	Average	0.269 g/L
Esso:	8 samples	Average	0.267 g/L
Petro Can:	10 samples	Average	0.304 g/L
Husky:	2 samples	Average	0.275 g/L
Other Brands:	22 samples	Average	0.264 g/L

6.2 Lead-Free Gasoline Monitoring

A total of 268 lead-free gasoline samples from 17 brands were collected from retail outlets in 22 municipalities in the Lower Mainland, Fraser Valley, and Okanagan area. Two samples exceeded the allowable lead content of 0.013 grams per litre. Both non-compliance samples occurred in the Vancouver area and were related to 2 different brands. This yields a non-compliance rate of 0.8% in B.C. or 0.9% in Vancouver. Further details of the results are tabulated in Tables 5 and 6.

6.3 Nozzle Survey

A total of 620 nozzles on leaded gas pumps were measured and 20 were undersized. This yields a nozzle switching rate of 3.2% as a B.C. average; 2.2% in Vancouver and 7.5% in the Okanagan area. Nozzle switching practices have generally decreased since 1985 when the switching rates were 9.4% as the B.C. average; 4.3% in Vancouver, and 18.0% in the Okanagan area. The results of the survey are presented in Tables 7 and 8.

6.4 Misfueling Survey

The survey was conducted at 7 gas stations of different brands in the Vancouver area. The locations were selected to provide a reasonable geographic distribution. Approval from the respective retail outlet was obtained prior to the survey. All 7 stations offered both leaded and unleaded gas and 2 stations had one of their leaded gas pumps equipped with a small size nozzle.

A total of 498 vehicle refuelings were observed, of which 296 cars were refueled with unleaded gasoline and 202 cars with the leaded grade. All of the 202 motorists using leaded gasoline were interviewed, and 8 of them were driving cars designed for unleaded gasoline. All 8 cars showed evidence of tampering with the fuel inlet restrictors, either by widening the restrictor or by removing it completely. All these 8 misfuelers stated that the catalytic converters on their vehicles had been removed. Seventy five percent (6 out of 8) of the misfuelers admitted that they always refuel with leaded gasoline and the reasons given varies from a lower price (which is not correct since April 1987), "just a habit", to that a mistake has been made. In April 1987, the provincial government tax increase of 2¢ per litre on leaded gasoline came into effect which resulted in a price equalization between the regular grades of leaded and lead-free gasoline.

During the survey, no motorist refused to be interviewed and the surveyor was able to interview all 202 leaded gasoline users.

Among the 202 users of leaded gasoline, none used an adaptor to refuel leaded gasoline to an unleaded car.

The survey also found that among the 8 misfuelers, 6 resided in Vancouver, 1 in North Vancouver, and 1 in Richmond.

The misfueling rate with respect to the brand name and location of gas station are summarized below:

Brand	Location	Misfueling Rate
Merit	Vancouver	18.8%
Shell	Vancouver	5.4%
Petro Can	Richmond	2.9%
Super Save	Vancouver	2.0%
Pay'N Save	North Vancouver	1.4%
Petro Can	Burnaby	0%
Texaco	Vancouver	0%

Among the 202 leaded gasoline users who were interviewed, the car size distribution was as follows:

Class	No. of Vehicles	Percent
4 Cylinders	85	42%
6 Cylinders	38	19%
8 Cylinders	79	39%

Among the 202 leaded gasoline users who were interviewed, the car age distribution was as follows:

Model Year	No. of Vehicles	Percent
1962-1974	90	45%
1975-1980	77	38%
1981-1985	25	12%
1986-1987	10	5%

The survey results are summarized in Table 9.

7 DISCUSSION

The leaded gasoline production plants in B.C. were in compliance with the amended Regulations since January 1987 when the amended Regulations became effective. However, 29% of the samples collected from retail outlets contained more than 0.29 g/L of lead. It appears that a grace period is necessary for the marketing system to clear out the 1986 gasoline stock which might contain up to 0.59 g/L of lead, as shown by the lead analysis results for samples collected in the 4th quarter of 1986. The average lead concentration of the samples from retail outlets was 0.28 g/L and was much higher than the average of the production samples (0.22 g/L). This may be caused either by the residual stock in the marketing system, or by fluctuating lead concentrations in the production plants.

The rate of lead-free gasoline contamination improved this year with a 0.8% non-compliance rate as compared to 1.4% in 1986 and 2.6% in 1985. Only 2 contaminated samples were found in Vancouver among the 268 spot samples. This reflects a positive and notable improvement in the gasoline marketing system and reflects improved quality control efforts by the petroleum industry.

The nozzle switching practice as a provincial average, has also improved to 3.2% in 1987 from 6.3% in 1986 and 9% in 1985. In Vancouver the rate was 2.2% in 1987 as compared to 2.3% in 1986 and 4.3% in 1985.

The vehicle misfueling survey showed that other than the determined vehicle misfuelers who removed the fuel inlet restrictors on their cars, there were no incidences of misfueling attributed to undersized nozzles. The public awareness efforts of the federal and provincial governments and industry appear to have had a positive effect on the public. In April 1987, the prices for regular grades of leaded and lead-free gasoline were equalized when the British Columbia government added a 2¢ per litre sales tax to leaded gasoline. ϟThis price equalization has removed what appears to have been a major incentive for some motorists to misfuel their cars.

Among the 202 motorists who refueled their cars with leaded gasoline and were interviewed in our survey, 8 had tampered with the fuel

inlet restrictors on their cars such that misfueling can be performed easily. The catalytic converters of these 8 cars had also been removed. These results indicate that 4% of leaded gasoline users are regular misfuelers who have also removed the catalytic converters from their cars. Due to resource constraints, the misfueling survey could not conduct interviews with motorists who refueled with unleaded gasoline. The total vehicles that are unleaded designated therefore cannot be rigorously determined. With the assumption that 70% to 100% of these cars are designed for unleaded gasoline, the misfueling rate is estimated in the range of 3-4%. However, there is a clear trend of decreasing misfueling incidents during the last 3 years:

	No. of Cars Surveyed	No. of Misfueling Cars
DOE National, 1985	433	38
B.C. 1986	481	15
B.C. 1987	498	8

TABLE 4 LEADED GASOLINE MONITORING - AREAS SAMPLED

Area Sampled	# of Stations from which Leaded samples were collected	# of Leaded samples collected	Non-compliances	Non-compliances
			total number	per cent
LOWER MAINLAND				
1) North Vancouver	4	4	3	75%
2) Burnaby	5	6	5	83%
3) Vancouver	2	2	2	100%
4) Surrey	10	11	3	27%
	21	23	13	57%
OKANAGAN				
1) Hope	4	4	0	0 %
2) Princeton	2	3	2	67 %
3) Hedley	1	1	0	0 %
4) Keremeos	2	2	0	0 %
5) Kaledon	1	1	0	0 %
6) Penticton	4	4	0	0 %
7) Summerland	1	1	1	100 %
8) Peachland	1	1	0	0 %
9) Westbank	1	1	0	0 %
10) Kelowna	4	5	1	20 %
11) Winfield	1	1	0	0 %
12) Vernon	4	4	0	0 %
13) Falkland	1	1	0	0 %
14) Monte Lake	1	1	0	0 %
15) Kamloops	4	5	0	0 %
	32	35	4	11 %
TOTAL	53	58	17	29 %

TABLE 5 LEAD-FREE GASOLINE MONITORING - AREAS SAMPLED

AREA SAMPLED	DATE(S) SAMPLED	# OF STATIONS	# OF SAMPLES	NON-COMPLIANCES	
				#	%
Lower Mainland					
Vancouver	May 7, 11	28	53	0	0
West Vancouver	May 5	10	19	0	0
Burnaby	May 7, 14	34	61	1	1.6
Richmond	May 25	16	29	0	0
North Vancouver	May 5, 7	18	32	1	3.1
Surrey	May 29	5	8	0	0
New Westminister	May 14	10	19	0	0
Subtotal		117	215	2	0.9
Okanagan					
	June 26				0
Princeton	"	2	4	0	0
Keremeos	"	2	3	0	0
Kaleden	"	2	2	0	0
Hedley	"	1	1	0	0
Penticton	June 27	4	7	0	0
Summerland	"	1	1	0	1
Peachland	"	1	2	0	0
Westbank	"	1	1	0	0
Kelowna	"	4	8	0	0
Winfield	"	1	1	0	0
Vernon	"	4	7	0	0
Falkland	"	1	1	0	0
Monte Lake	"	1	1	0	0
Kamloops	June 28	4	8	0	0
Hope	June 26	4	6	0	0
Subtotal		32	53	0	0
TOTAL		149	268	2	0.8

TABLE 6 LEADED AND LEAD-FREE GASOLINE MONITORING NON-COMPLIANCES

SAMPLE #	A.A. TEST (Pb) g/l	BRAND	GRADE	LOCATION	SAMPLING DATE
LM-052	0.014	Super Save	R.U.	N. Van.	87-05-07
LM-154	0.021	Chevron	R.U.	Burnaby	87-05-14
LM-051	0.300	Shell	R.	N. Van.	87-05-07
LM-053	0.320	Super Save	R.	N. Van.	87-05-07
LM-055	0.340	Petro Can	R.	N. Van.	87-05-07
LM-061	0.300	Mohawk	R.	Burnaby	87-05-07
LM-064	0.340	Domo	R.	Burnaby	87-05-07
LM-069	0.380	Chevron	R.	Burnaby	87-05-07
LM-078	0.380	Texaco	R.	Burnaby	87-05-07
LM-080	0.390	Pay'n Save	R.	Burnaby	87-05-07
LM-088	0.350	Domo	R.	Vancouver	87-05-07
LM-091	0.400	Super Save	R.	Vancouver	87-05-07
LM-211	0.304	Petro Can	R.	Surrey	87-05-29
LM-235	0.322	Texaco	R.	Surrey	87-05-29
LM-238	0.342	Esso	R.	Surrey	87-05-29
OK-013	0.310	Mohawk	R	Princeton	87-06-26
OK-016	0.390	Chevron	P.L.	Princeton	87-06-26
OK-040	0.530	Petro Can	R	Summerland	87-06-26
OK-055	0.310	Petro Can	R	Kelowna	87-06-27

TABLE 7 NOZZLE SURVEY - BRITISH COLUMBIA

Total Number of Stations Surveyed : 149
Total Number of Leaded Nozzles Measured : 620
Total Number of Undersized Nozzles : 20 (3.2%)

BRAND	NO. OF STATIONS	NO. OF UNDER-SIZED NOZZLES	% OF STATIONS W/ UNDERSIZED NOZZLES	NO. OF LEADED NOZZLES	NO. UNDERSIZED	PERCENT UNDERSIZED
CHEVRON	27	3	11.1	156	3	1.9
SHELL	21	1	4.8	86	1	1.2
PETRO CAN	25	0	0	97	0	0
ESSO	22	2	9.1	88	0	0
TEXACO	13	0	0	54	0	0
SUPER SAVE	9	6	66.7	30	13	43.3
MOHAWK	8	0	0	31	0	0
GULF	4	0	0	14	0	0
DOMO	3	0	0	12	0	0
BEAVER	2	0	0	9	0	0
PAY'N SAVE	5	0	0	14	0	0
TURBO	3	1	33.3	8	1	12.5
REBEL	1	0	0	4	0	0
HUSKY	3	0	0	10	0	0
TEMPO	1	0	0	1	0	0
MAD MAX	1	0	0	3	0	0
ECONO	1	0	0	3	0	0
	149	13	8.7	620	20	3.2

TABLE 8 NOZZLE SURVEY - LOWER MAINLAND

Total Number of Stations Surveyed : 117
Total Number of Leaded Nozzles Measured : 500
Total Number of Undersized Nozzles : 11 (2.2%)

BRAND	NO. OF STATIONS	NO. W/ UNDER-SIZED NOZZLES	% OF STATIONS W/ UNDERSIZED NOZZLES	NO. OF LEADED NOZZLES	NO. OF UNDER-SIZED NOZZLES	PERCENT UNDERSIZED
A. BRAND						
CHEVRON	22	1	4.5	123	1	0.8
SHELL	19	0	0	890	0	0
PETRO CAN	19	0	0	79	0	0
ESSO	16	0	0	68	0	0
TEXACO	13	0	0	54	0	0
SUPER SAVE	7	4	57.1	24	10	41.7
MOHAWK	5	0	0	17	0	0
GULF	3	0	0	12	0	0
DOMO	3	0	0	12	0	0
BEAVER	2	0	0	9	0	0
PAY'N SAVE	3	0	0	8	0	0
TURBO	2	0	0	6	0	0
REBEL	1	0	0	4	0	0
HUSKY	1	0	0	3	0	0
TEMPO	1	0	0	1	0	0
	117	5	4.3	500	11	2.2
B. AREA						
Burnaby	34	2	5.9	150	7	4.7
Vancouver	28	1	3.6	117	2	1.7
North Vancouver	18	1	5.6	82	1	1.2
Richmond	16	0	0	62	0	0
Surrey	10	1	10.0	51	1	2.0
West Vancouver	10	0	0	34	0	0
New Westminster	1	0	0	4	0	0
	117	5	4.3	500	11	2.2

TABLE 9 INFORMATION ON MISFUELED CARS

ID	VEHICLE				AREA OF		FREQUENCY OF LEADED USEAGE	UN-LEADED LABEL	CAT. CONV. REMOVED	FREQ. TUNE-UP	MILEAGE	REASON GIVEN FOR MISFUELING
	YEAR	MAKE	MODEL	NO. OF CYLINDERS	RESIDENCE	SURVEY						
25	77	FORD	LTD	8	VANC.	VANC.	SOMETIMES	Y	Y	1/yr.	9-10 MPG	Mistake
52	75	FORD	LTD	8	VANC.	VANC.	ALWAYS	Y	Y	3-4 mo.	15 MPG	Engine Converted
56	76	PONT.	PARISIENNE	8	VANC.	VANC.	ALWAYS	Y	Y	1/yr.	22 MPG	None
58	79	DODGE	ASPEN	6	VANC.	VANC.	SOMETIMES	Y	Y	3-4 mo.	17 MPG	Cheaper
103	75	CHEV.	MALIBU	8	RMD	RMD	ALWAYS	Y	Y	2000 mi.	9-10 MPG	Cheaper
137	78	PLY.	VOLARE	6	VANC.	VANC.	ALWAYS	Y	Y	2/yr.	15 MPG	Cheaper
143	77	CHEV.	MALIBU	8	VANC.	VANC.	ALWAYS	Y	Y	Seldom	18 MPG	Habit
165	76	PONT.	SUNBIRD	6	N. VANC.	N. VANC.	ALWAYS	Y	Y	6 mo.	unknown	Cheaper

All fuel inlet restrictors were removed.

APPENDIX I

DATA RECORDING FORMAT
FOR THE MISFUELING SURVEY

SERVICE STATION RECORD

1. Service Station Brand Name: _____

2. Type of Service Station: Full Serve _____ Self Serve _____
   Both Full and Self Serve _____

3. Types of Gasoline Available: Leaded Only _____
   Lead-Free Only _____
   Both _____

4. Incidence of Nozzle Substitution:
   Number of Leaded Pump Nozzles _____ ID _____
   Number of Undersized Nozzles _____ ID _____

5. Total Number of Motorists using: Unleaded _____
   Leaded _____
   Total _____

6. Total Number of Motorists using Undersized Nozzles _____

7. Total Number of Unleaded Vehicles using Leaded Gas _____

8. Misfuelling Rate: _____%

SURVEY FORM NO. 2

CAR MAINTENANCE AND FUEL USE

We appreciate your cooperation in providing information on the type of fuel used in your car. This survey is being conducted by the Federal Department of Environment. The collected information will be helpful to assess the vehicle emissions contributed to air pollution in Vancouver.

1. ID NUMBER _____ PUMP NO. _____

2. MAKE _____ MODEL _____
   YEAR _____

3. SIZE CLASS: COMPACT (4 cylinders) _____
   MID-SIZE (6 cylinders) _____
   FULL-SIZE (8 cylinders) _____

4. AREA OF RESIDENCE: _____

5. FUEL DESIGNATION: UNLEADED _____ LEADED _____

6. FREQUENCY OF LEADED GASOLINE USAGE:
   Always _____ Often _____ Regularly _____
   Sometimes _____ Rarely _____

7. UNLEADED LABEL: Yes _____ No _____

8. FUEL INLET RESTRICTOR: Present _____ Absent _____

9. CATALYTIC CONVERTER: Present _____ Absent _____

10. How often do you tune your car? _____

11. What is the gas mileage? _____

12. "I would like to ask you why you use leaded gasoline in your vehicle rather then unleaded?" _____

APPENDIX II

HISTORICAL DATA ON
LEAD-FREE GASOLINE CONTAMINATION

APPENDIX II

TABLE 1 NUMBER OF CONTAMINATED SAMPLES (1974-1987)

YEAR	NO. OF CONTAMINATIONS IDENTIFIED IN EPS (Pacific & Yukon Region) MONITORING PROGRAM									TOTAL NO. OF SAMPLES
	C	B	D	A	E	H	F	G	OTHERS	
1974	1	1	2	2	1	0	0	0	0	317
1975	-	-	-	-	-	-	-	-	3	207
1976	0	2	1	2	3	0	0	1	3	284
1977	0	1	2	5	1	0	1	0	1	637
1978	0	0	1	3	2	0	0	0	0	93
1979	1	2	2	1	5	0	2	2	0	155
1980	1	3	2	2	0	0	1	0	0	273
1981	7	3	2	7	1	1	1	-	2	350
1982	-	-	-	-	-	-	-	-	-	-
1983	1	1	0	3	1	0	0	0	0	331
1984	0	3	2	0	0	1	1	1	2	398
1985	2	2	3	2	0	1	1	2	2	567
1986	0	0	2	0	1	0	2	0	0	358
1987	0	0	0	1	0	0	0	0	1	268
TOTAL	13	18	19	28	15	3	9	6	14	4238/125

A = CHEVRON

B = SHELL

C = ESSO

D = GULF

E = PETRO CAN (Formerly PACIFIC and GULF)

F = TEXACO

G = MOHAWK

H = HUSKY

APPENDIX II

TABLE 2 LIST OF CONTAMINATED LEAD-FREE GASOLINE (1974-1981)

YEAR	LEAD CONCENTRATIONS (g/IG) IN THE IDENTIFIED CONTAMINATIONS								
	C	B	D	A	E	H	F	G	OTHERS
1974	0.950	0.230	0.123 0.076	0.064 0.068	0.072	- -	- -	- -	- -
1975	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	0.190 0.180 0.080
1976	-	0.110 0.070	0.090	0.090 0.070	0.090 0.070 0.150	-	-	2.000	0.420 0.320 0.080
1977	-	0.127	0.180 0.230	0.090 0.080 0.190 0.080 1.000	0.123	-	-	-	-
1978	-	-	0.062	0.163 0.079 0.149	0.089 0.064	-	-	-	-
1979	0.086	0.244 0.244	0.065 0.244	0.082	0.076 0.263 0.147 0.101 0.168	-	0.063 0.147	0.282 0.263	-
1980*	0.074	0.071 0.063 0.078	0.942	0.068 0.065 0.188	-	-	0.090	-	-
1981*	0.220 0.076 0.093 0.082 0.063 0.068 0.069	0.070 0.200 0.200	0.130 0.100	0.200 0.085 0.088 0.096 0.072 0.062 0.074	0.065	0.150	0.150		0.200 0.104

* Data of Whitehorse Branch included

APPENDIX II

TABLE 3 LIST OF CONTAMINATED LEAD-FREE GASOLINE (1982-1986)

YEAR	LEAD CONCENTRATIONS (g/l) IN THE IDENTIFIED CONTAMINATIONS								
	C	B	D	A	E	H	F	G	OTHERS
1982	-	-	-	-	-	-	-	-	-
1983	0.0172	0.0172	0	0.066 0.0273 0.048	0.026	0	0	0	0
1984	0	0.044 0.030 0.016	0.030 0.017	0	0	0.017	0.037	0.037	0.040 0.021
1985	0.018 0.030	0.040 0.028	0.015 0.014 0.031	0.028 0.021	0	0.042	0.023	0.018 0.030	0.014 0.015
1986	0	0	0.077 0.020	0	0.016	0	0.110 0.023	0	0
1987	0	0	0	0.021	0	0	0	0	0.014